

Is adaptive management helpful for developing new harvesting technique and equipment¹⁾

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Abstract Faced with the conflict between the environmental protection and timber production, the concept of new forestry and the effect of new forestry objectives on existing harvesting techniques and equipment have been introduced. Adaptive management—a help tool for developing new harvesting techniques and equipment has been proposed. An adaptive approach for developing a forest harvesting for new forestry should be composed of careful planing, considerable hypotheses, detailed testing and evaluating as well as correct and fast feedback. New forestry practices are by no means easy because the complexity of the problem and almost every thing is new. We will see more successful new harvesting techniques and equipment being developing by adaptive approach for new forestry in the future.

Key words: Environmental protection, Timber production, New forestry, Adaptive management

New Forestry

New Forest is a concept developed by a group of forest ecologists (Franklin 1989) in Oregon and Washington as way by which to manage forest land to conserve a range of old-growth values while at the same time allowing for the extraction of commodities such as timber (Kimmins 1992).

The major concepts in New Forestry can be divided into two groups: new approaches to stand-level management and new patterns of landscape-level management. The ideas include longer rotations; partial cuts rather than clearcutting where this is ecologically appropriate, and a variety of clearcut sizes with a number of mature

Live trees kept to provide wildlife habitat and future supply of snags. Other key points include: maintenance of a minimum number of snags as habitat for cavity-nesting birds and mammals and as a source of food for birds that eat wood-boring insects, retention of a minimum level of large decomposing logs as habitat for small mammals, amphibians, and other organisms, and removal of less wood per hectare at harvest time in order to maintain site organic matter resources and carbon storage. It has been suggested that implementation of this system could lower the yield of logs from the forest by as much as 25 per

cent in some cases, and that much of this volume loss would be in the more valuable large-diameter logs. In some shelter-wood cuts in Oregon that are now being considered for green tree retention 30% to 50% of the volume may be reserved.

New forestry objectives

Pressure from wilderness advocacy groups for the reservation of old-growth forest and wilderness areas in the western United State and Canada has grown rapidly over the past decade. In Oregon and Washington, large areas of public forest may be removed from the working forest (the area of forest dedicated to management for multiple resource values including timber production) and assigned to wilderness or endangered-species-protection forests. The extent of these reserves and the prospect that the size of the working forest may continue to change in the future as a result of such pressure has significant implication for other social values from the forest. It is rendering the rational planning of forest management very difficult, and in some cases is reducing the willingness of forest companies to make long-term investments in forest improvement. In the northwest pacific, timber production is also very important. FEMAT points out that the federal forests in the Owl region will be managed under a non-declining yield mandate—meaning the planned harvest level in future decades cannot be less than the current decade's

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planned harvest level (FEMAT report 1992).

Faced with the conflict between the environmental protection and timber production, New Forestry is an attempt to move environmentalists away from their preoccupation with forest preservation, and to persuade production-oriented forester to develop and use systems of silviculture and forest management that maintain environmental and wildlife values normally found only in unmanaged old-growth forest. New Forest, it is suggested, offers an alternative between preservation and intensive timber harvesting. Rather than setting aside additional large areas of old growth in no-management reserves, New Forestry advocates propose that most managed forests should be managed under New Forestry regimes. It is suggested that these would conserve wildlife values that are said to be threatened, would maintain or increase biodiversity, and would protect the ecosystem's ability to withstand stress and recover from disturbance-its resilience (Kimmins 1992).

Effects of new forestry objectives on existing harvesting techniques and equipment

There are mainly three kinds of harvesting methods in the Pacific Northwest; (1) clearcutting, (2) thinning, and (3) shelterwood. There are mainly two types of harvesting equipment in the Pacific Northwest: cable and ground vehicle. Cable includes (1) running skyline, (2) standing skyline, (3) live skyline and (4) multispans. Ground vehicle includes rubber tire skidders and crawler tractors. The New Forestry Objectives have effects both on harvesting methods and harvesting equipment. On harvesting methods, it will affect clearcutting most, because green trees and snags are needed to be left in the cutting areas. In this way, it will cause difficulty in harvesting and also working hazards for the workers because they have to working under snags that are easy falling down. On harvesting equipment, the New Forestry Objectives require equipment which are smaller in size, high maneuverability, and less damage on soil. Kellogg (1991) points out that important logging technologies for High Quality Forestry that will need to replace some convention logging technologies are small yarders, slackpulling carriages, multispans, substitute earth anchors, mechanization and helicopters. Kimmins (1992) points out that cable systems such as the skyline system can significantly reduce the environmental impact of harvesting because of the reduction in roading, especially in steep terrain. However, these cable systems operate most efficiently in clearcuts and may be uneconomic or impractical in uneven-aged forest or small patchcuts. New cable systems are being designed that may make it possible in the future to use these more environmentally-friendly log-removal systems economically in non-clearcut

harvesting.

Adaptive management--a help tool for developing new harvesting technique and equipment

Adaptive management applies the concept of experimentation to the design and implementation of natural-resource and environmental policies. An adaptive policy is one that is designed from the outset to test clearly formulated hypotheses about the behavior of an ecosystem being changed by human use. If the policy succeeds, the hypothesis is affirmed. But if the policy fails, an adaptive design still permits learning, so that future decisions can proceed from a better base of understanding (Lee 1992). In this statement, Kai Lee points out two important principles of adaptive management: experiment and feedback.

Experiment, in engineering or other scientific field, is usually carefully and scientifically designed. In a laboratory experiment, the important thing is randomization. Randomization can guarantee inferential validity in the face of unspecified disturbances. That is to choose population randomly, and to arrange the order of experiments randomly. Before the experiment, people need to make assumption about the conditions of the experiment; people will have hypotheses about the experiment. When doing the experiment, people should carefully control the experiment conditions to avoid systematic error. After the experiment, people will carefully examine the results and test the hypothesis. They will adjust next experiment according to the experiment results (Feedback). Managing ecosystem like doing an experiment should act in the same way as far as possible although there are many differences between ecosystem management and laboratory experiment. Kai Lee points out that in a laboratory the experimenter can randomly choose subjects and controls, but in adaptive management, it is difficult, because most populations in a policy setting are not random, and also because of the ethical and political reasons.

Feedback, it is an important feature for any kind of adaptive method, management, and system. Without feedback, there will be no good control. For example, in aiming to achieve a sustainable forest resource, if we cut more than annual growth in a year, we should cut less next year according to the negative feedback; otherwise cut more.

The principles of adaptive management are also helpful for developing new harvesting techniques and equipment.

Using adaptive approach to develop new harvesting equipment is easier to understand because it is similar to engineering experiment. That is, the factory design a piece of equipment according to the requirements of the New Forestry harvesting methods, then do field test, and do redesign according to the

feedback of the first design. In this process, adaptive approach has been here for a long time. For the harvesting operations, adaptive management approach is a new idea. Even people also did planing, testing, results analyzing in the past, but this process was much simple compared with requirements of New Forestry. Furthermore people usually did not have considerable hypotheses about the operation and the feedback was not adequately used forest experiment. An adaptive approach for developing a forest harvesting for New Forestry should be as following:

Careful planing: Edwards *et al* (1992) point out Logging planning was found to be the key to operationally efficient, cost effective group selection harvesting. The planning should not only consider logging elements, but also consider ecological, wildlife, and other New Forestry elements.

Considerable hypotheses: The aim of the operation, what will happen after the operation should be thoughtful. One of the differences between the adaptive approach and nonadaptive approach is that the former has considerable hypotheses.

Detailed testing and evaluating: Adaptive approach for New Forestry need extensive testing to evaluate how effective it will be in providing habitat for mature-forest wildlife. Testing and evaluating of a harvesting operation is not only in harvesting cost, but also on other impacts of the operation, such as soil, wildlife, etc.

Correct and fast feedback: Feedback for the next experiment should be correct which depends on the testing and evaluating the results. It also should be fast because of the first experiment can only be correct in certain time period.

According to these criteria we can evaluate the three responses to New Forestry mentioned above. For the first two experiments, they used some adaptive management principles during their research, for example, treating the logging operations as experiments, but they were weak in hypotheses and testing, because they only tested logging cost. For the last research, it was good example of adaptive manage-

ment in developing harvesting techniques for New Forestry, because what they did met the four criteria above.

Conclusions

New Forestry practices have been used recently and researchers are now trying to use adaptive approach to developing new harvesting techniques and equipment. Of course these processes are by no means easy because the complexity of the problem, and all most everything is new: New Forestry, New adaptive approach, New technique and new equipment. New things have brought future. We will see more successful new harvesting technique equipment being developed by adaptive approach for New Forestry in future.

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